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Virtual Reality Games in EFL Class: Examining Learners' Vocabulary Learning

Langgeng Budianto

Universitas Islam Negeri Maulana Malik Ibrahim Malang

Suparmi Suparmi

Universitas Islam Negeri Maulana Malik Ibrahim Malang

Biyanto Biyanto

Universitas Islam Negeri Sunan Ampel Surabaya

Siti Nurul Azkiyah

Universitas Islam Negeri Syarif Hidayatullah Jakarta

Introduction

Virtual reality (VR) is “a computer technology that gives the illusion, to those who use it, of being immersed in a virtual environment that does not really exist. It is a computer simulation of a real situation where the human subject may interact with the virtual environment, sometimes by the means of non-conventional interface like glasses and helmets on which the scene is represented and the sounds reproduced” (Fassi et al., 2016. p. 140). VR games are popular among children, teenagers, and adults because the games are fun and exciting to play. With the popularity of VR, it is predicted that global users will exceed 337 million in 2025 (Huawei’s GIV, 2019). Currently, VR games are actively being integrated as a teaching and learning apparatus to support teacher’s teaching and learner’s learning experiences (Alfadil, 2020; Radianti et al., 2019). Because of the popularity of VR in language teaching and learning, this application has been applied into foreign/second language learning in 2000’s (Alfadil, 2020; Chien et al., 2020; Rau et al., 2018; Tai et al., 2020).

The impacts of VR on improving vocabulary (Alfadil, 2020; Tai et al., 2020), speaking (Chien et al., 2020), writing performance (e.g., Dolgunseoz et al., 2018; Parong& Mayer, 2018; Peeters & Dijkstra, 2018) and speed reading (Rau et al., 2018) have been acknowledged using a quantitative approach and the interpretation of the research findings merely emphasizes on score improvement. This intervention model is effective in providing statistical evidence, but it cannot unveil learners’ learning processes during learner-VR interaction. Through VR teachers and students can explore exact information and object visualizations that are impossible to experience in real life using bare eyes (Alfadil, 2020). However, there is still limited study on foreign language vocabulary acquisition through VR technology using quantitative and qualitative approaches at the same time to explore both learning processes and outcomes.



Literature Review

Virtual Reality Games in Education

VR refers to one of the computer technologies that offer a realistic context of situation in which learners can engage and interact with virtual objects in the application to encourage learning experiences in the real-world context (Ghanbarzadeh et al., 2014). VR games are well-known across different ages because they offer exciting and fun activities to play. Besides the negative effects of VR games for children as they become addicted to play and reduce their learning time, research reveals that VR games can be used to promote learners' language skills (Alfadil, 2020; Wang et al., 2019).

Based on the study of Alfadil (2020), VR games promote learning and build necessary skills because VR games provide psychological and mental challenges to the users or players. The research suggested that VR games are computer games with entertainment characteristics, but they can be designed for various purposes like training and education. In Malaysia, an inquiry on computer and VR game-based learning found that the Educational VR Games (EG) are very engaging and motivating for the students. A VR environment can also situate learners in realistic learning contexts that they cannot encounter in real life. In physics and astronomy, for example, VR helps learners develop higher order thinking skills and more complex problem-solving activities.

In broader educational settings like physics, astronomy, medical and other areas, VR games have provided their advantages for supporting learners' learning motivation, communicative skills, cognitive skills, and other positive learning experiences. Most of the previous studies in an educational context have introduced the merits of VR games for promoting learners' motivational reactions and learning outcomes. However, in the area of second or foreign language learning, it has been relatively sparse regarding the implementation of VR games to enhance learners' vocabulary learning process during interaction with VR games.

Virtual Reality Games and Language Learning

VR game is an interactive computer-based game using multimedia environments in which the player becomes a participant of the game in a "virtually real" context (Parisi, 2016). According to Parisi (2016), VR can provide foreign/second language (EFL/ESL) learners with virtual simulation for language learning (Lan et al., 2019). It also provides interaction and exploration spaces for promoting learners' language learning (Wang et al., 2019). Regarding the use of VR games for EFL/ESL learning, most quantitative researchers tended to investigate learners' learning products as the results of comparing between intervention and control groups and the qualitative researchers have mainly focused on affective factors such as motivation and self-efficacy. How learning occurs during interactive play with VR games has not been studied yet.

The first part discusses previous studies which emphasize learners' learning outcome rather than the process. Chien et al. (2020), for example, compare the effectiveness of peer assessment for Taiwanese junior high school students in the context of a spherical video-based virtual reality (SVVR) and non-peer assessment with the same SSVR context in terms of speaking performance, motivation, critical thinking, and anxiety. The results indicate that students who used the peer-assessment with SSVR context outperformed the counterpart group in terms of fluency, comprehension, and language maturity.

In the same setting in a Taiwanese junior high school context, Thai et al. (2020) conducted an experimental study using VR app (HMDs) to improve EFL students' vocabulary learning and their learning retention. The findings reported that VR application can enhance students' vocabulary learning and retention because it has multimodal support and real-time interactivity. The students also revealed positive responses towards the implementation of VR for vocabulary learning.

In addition, Rau et al. (2018) compared three different multimodal applications using time pressure with VR, augmented reality (AR), and LCD and their possibility to enhance 63 Chinese college students' reading

performance. The results showed that the students' response time on VR and AR were ten percent longer than that reading on LCD, but the students' speed reading and comprehension scores indicated no significant difference among the three devices.

The second part discusses previous studies which emphasize learners' affective factors such as motivation and efficacy. Investigating learners' psychological perspectives could provide supporting data regarding the psychological dimension of learning.

Overall, the above literature studies emphasize that the affordances of VR as a learning tool enable learners to visualize and interact with virtual objects, all of which promote language learning. VR is recognized to be motivational and supportive in a language learning context. However, none of them have investigated the learning process during learners' interaction with VR tools. The study aims at answering these research questions:

1. Do EFL learners perform better in vocabulary meaning after they are taught using VR game activities?
2. How do VR games facilitate EFL learners' vocabulary learning?

Methods

Design

Applying mixed-method designs, the researchers adopted quasi-experimental and interview methods to explore students' vocabulary learning improvement, their perceived attitudes and vocabulary learning process using VR games. First, the quasi-experimental designs enable the researchers to manage the situation so that causal relationships among variables can be evaluated (Cooper & Schindler, 2008). Second, the qualitative analysis using interview designs enabled the researchers to manage the research situation so that learners' learning patterns can be generated.

Participant and Context

The participants involved 50 EFL students from two intake classes, taught by the same English lecturer, at an Islamic public university in Indonesia. There were 10 male and 15 female students in the intervention group (N=25) and 10 male and 15 female students in the control group. The research participants were all native Indonesian speakers; none of them had studied in an English-speaking country. Their ages were 20-21 years. They had learned English for about 8-9 years from their previous formal education. They had similar English proficiency levels based on TOEFL scores and academic grades, with most participants demonstrating an intermediate level of English proficiency. None of them had ever used VR apps for language learning.

Instruments

VR games application

The VR games activities were taken from *Mondly* application (<http://www.mondlylanguages.com>). This web site could be downloaded from the Oculus store (<https://www.oculus.com/experiences/gear-vr/>). This application has been widely applied for language learning purposes such as House of languages and Mondly applications. The Mondly VR games provide replications of real-life scenarios such as at the restaurant, train, taxi, and hotel.



Figure 1. Sample of VR game activities.

Vocabulary tests

A vocabulary test consisting of 30 words was given to the participants during pre- and post-test sessions. The test was developed by the researchers and reviewed by three lecturers who taught assessment and vocabulary courses. The researchers developed the vocabulary test based on Wesche and Paribakht's (1996) model of Vocabulary Knowledge Scale (VKS). The basic notion of the scale is to measure students' understanding of the meaning of the word. The vocabulary items consisted of four different topics based on the VR games the students had played previously. In this case, the students have to rate how well they understand the meaning of the word.

TABLE 1

Sample of Vocabulary Knowledge Scale (VKS)

	Words	Levels*)			
		1	2	3	4
1.	Sloths				
2.	Appetizer				
3.	Receipt				
4.	Boarding pass				
5.	Premiere				
30.	Departure				

*) Mark the appropriate column for each word and provide an answer.

1: I don't remember coming across this word before

2: I have seen this word before but I don't know what it means

3: I have seen this word before and I think it means _____ (synonym or translation in Bahasa)

4: I know this word. It means _____ (synonym or translation in Bahasa)

Semi-structured interview

The researchers conducted semi-structured interviews with all research participants to collect in-depth qualitative data supporting the quantitative data. The themes of the semi-structured interviews were their experience of vocabulary learning using VR games: associating, predicting, outsourcing (Chen, 2016).

Procedures and Analysis

After obtaining permission from the dean and the head of department, a vocabulary pretest was administered to all study participants one week before the intervention. Then, the researcher's team introduced the operation of the Mondly VR app and Samsung VR gear to certify that they understand how to operate the applications. The learning activity was not applied individually because of the limited number

of the VR tool which was only ten pieces. So, they used it in turn. To accomplish the tasks in the Mondly apps, they had to navigate and interact with the virtual characters and objects inside the VR games, which took around 30–45 min. The students in the control group were assigned to watch the same VR video game but they could not play the game like the students in the experimental group. After the treatments, the participants were given a vocabulary knowledge posttest and an interview.

To determine the score differences between the two groups regarding their vocabulary knowledge, an independent-samples *t*-test was applied to compare the vocabulary test scores. Finally, the interview data were coded into three themes, namely: motivation, interactivity, and experience. The coding results were then analyzed and interpreted by the researcher and the two of his research teams.

Results and Discussion

Results

Research question (RQ1): Do EFL learners perform better in vocabulary meaning after they are taught using VR game activities? The individual scores from pre-test and post-test were calculated by summing the rating of each student, with the total rating of the VKS from 30 to 120. Before the researchers tested the hypothesis, they had to establish that there were no initial differences of pre-test scores between the experimental and control groups. Table 2 and Table 3 reveal the results of pre-test average scores and the equal variances of the experimental group and control group.

TABLE 2
Mean and Standard of Deviation for Both Groups

	Mean	Standard Deviation	<i>N</i>
Pre-test			
Experimental	59.75	15.68	25
Control	60.04	15.06	25
Total	59.90	15.37	50
Post-test			
Experimental	82.63	19.40	25
Control	72.05	14.06	25
Total	77.34	16.73	50

Table 2 illustrates the average scores of pre-tests and post-test of the intervention and control groups. The pre-test average mean for the experimental group was 59.75 and 60.04 for the control group.

TABLE 3
Independent Sample t-Test: Pre-Test

Pre-test	<i>F</i>	Sig.	<i>T</i>	<i>df</i>	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal Variance Assumed	.069	.779	.137	64.000	.827	.5120	3.212	-6.452	7.5674
Not Assumed			.137	63.912	.827	.5120	3.212	-6.452	7.5674

Table 3 reveals the equal variance of the samples in both groups ($p=.775$). It also indicates that there were no statistically differences in pre-test between the students in the intervention and control groups [$t(137) = 64; p > .05$ two tailed], verifying the two groups had the same vocabulary level at commencement of the treatment or experiment.

TABLE 4
Independent Sample t-Test: Post-Test

Pre-test	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal Variances Assumed	9.68	.001	2.47	63.00	.013	11.212	4.066	2.362	19.074
Not Assumed			2.47	54.24	.013	11.212	4.066	2.567	19.027

Table 4 reveals that the variance of samples for post-test vocabulary scores were not equal ($p = .001$). So, we did not use assumed equal variances in the independent sample test. The analysis results also indicated statistically-significant differences in vocabulary scores in the post-test session. The students who learned vocabulary using VR games and those that did not [$t(54.24) = 2.47$; $p > .05$ two tailed].

TABLE 5
Independent Sample t-Test: Differences of Scores between Pre- and Post-Test

Difference	Levene's Test for Equality of Variance		t-test for Equality of Means					95% Confidence Interval of the Difference	Lower	Upper
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference			
	Equal Variances Assumed	24.65	.000	4.26	67.00	.000	10.442	2.223	5.216	16.752
Not Assumed			4.26	46.65	.000	10.442	2.223	5.087	16.773	

Table 5 represents the variance of samples for the differences between pre-and post-test which were not equal ($p = .000$), and it also reveals that the variance of the independent samples test was not assumed. The analysis results show that a statistically-significant difference exists in the students' VKS scores between the pre-test and post-test of the two groups [$t(38.25) = 8.26$; $p < .05$ two-tailed].

Research question (RQ2): How do VR games facilitate EFL learners' vocabulary learning? Commonly, learners learned vocabulary through associating the English caption with the VR game activities and their context. Some of them also predicted the meaning of the English subtitles. The rest of the students learned vocabulary through resources by translating and asking the meaning of the unfamiliar words to their friends after playing the games. In this study, the students' quotes were taken from random interviews regarding their abilities in providing the correct translation or synonym of the vocabulary meaning from the result of VKS tests. The detailed extracts are presented below:

I like to interact in the virtual world with real objects and characters at eye level. When I find an interesting object, I often pause the game to see the objects and I usually listen to the words or sentences repeatedly. I remembered the words easier because the virtual objects, characters' body language, and environment helped me associate correct meaning.

I have never gone to an airport before and I do not understand the meaning of *boarding pass* but after I watch many passengers are waiting in the waiting room before they enter the airplane. When all passengers showed their boarding pass while they were entering the hallway to their seat.

These excerpts show that the students who played the VR game can associate the meaning of the unfamiliar words through guessing the characters' body movement, objects and environments. It also

implied that the combination of multimodal elements plus real-life environment (virtual) facilitated the students to predict the meaning of the words correctly. The second script provided a clear example of how a learner predicts the meaning of the word *boarding pass* by looking at it as the real-objects in the VR game.

The next part explains the students' learning strategies through googling and questioning their friends for confirming the predicted word meaning.

When I feel uncertain about the meaning of these words *take off* and *departure*, I google to convince myself the correct meaning of those two identical words. After googling, I can understand the meaning of them. The first word denotes when the plane is going to fly and the second refers to a venue or abstract.

I ask my friend about the meaning of dessert after I finish my VR game. I do not understand the sentence when an attendant offers me do you want some dessert. Then, I tried to look for the meaning in the google translate and confirm to my friend that the meaning is right.

This part explains how the learners learning unfamiliar words in the VR game through Google Translate before they ask their friend the correct meanings of the words. The excerpts indicate that the students liked to use Google Translate to find the correct meaning of the words that they did not know. It seemed that this tool is not enough for them to find the correct meaning. So, they discuss it with their friends to find the correct meaning of the unfamiliar words.

Discussion

The first research objective deals with the impact of the VR game app on EFL learners' vocabulary learning processes and outcomes. The statistical analysis results showed that the students who learn vocabulary meaning using VR game app was significantly better than the students who watched the VR video game. The finding corroborates with the previous studies by Thai et al. (2017) and Alfadil (2020). Those two studies also demonstrated the merits of VR on EFL vocabulary learning. This disparity may relate to the impact of VR games app, which possibly help the players (the students who played the VR games) hold the target words or vocabulary better than the common non-VR video watchers (the students who watched the video games). Although, previous studies have indicated that video games enhance learners' vocabulary learning because they offer multimodal elements, namely verbal and visual representation, in this present research, the effectiveness of the video games seemed limited.

There are some reasons for the different results between the current and previous research findings. The current VR game provided more environmental stimuli and real-life activities in virtual formats. The students could play and act as virtual subjects or players of the game. The students could practice doing real activities in the virtual space while they read the English captions on the game. Practicing to say aloud the vocabulary and perform as the English subtitle could promote their comprehension of the meanings of the words and virtual performance (Alfadil, 2020; Thai et al., 2017). They can interact with other virtual objects through the VR game. Meanwhile, students in the non-virtual game received no opportunities to interact to the object in the video as they only watch the video and listen to the audio. The students from the non-VR video learned from limited stimuli as they could watch performing actors in the game and the English subtitles, but they could not act virtually. Learning only happened from audio and visual element (Arifani, 2020; Perez et al., 2018).

The second research question explores how VR games facilitate the EFL students' vocabulary learning. VR games provide rich stimuli and contextualized vocabulary. From the virtual environment, contextual information, visualization, and multimodal support, the VR games helped the students associate the vocabulary meaning. These findings are in line with previous VR and vocabulary learning using experimental research (Alfadil, 2020). The qualitative findings of this present study add the vocabulary learning processes using association strategies. The students could infer new word meanings from those

supportive elements. For example, the students from the VR group wrote down the meaning of the following words: *take off, departure, bill, luggage, receipt and dessert*. Some of the students who play the VR games often utilized the zoom-in function to see the object closer from multiple angles. Previous findings reported the use of zoom-in function and focused gazed on the virtual objects in the VR games could enhance learners' attention and learning (Lan et al., 2019; Thai et al., 2017). These activities made word meanings easier to remember (Alfakil, 2020).

Another finding was that the students also often asked their friends about the meaning of the unfamiliar words after they played the VR games and some of them googling the meanings of the unfamiliar words while they imitated the characters' words in the game. These activities indicate that VR game triggered students' vocabulary learning through outsourcing strategies. The use of VR games, previous studies have indicated the advantages of google translating tool as a media for understanding the word meaning and objects when the learners could not understand the unfamiliar words (Arifani, 2020).

Conclusion

The objective of this inquiry was to explore the impact of the VR game app on EFL learners' vocabulary learning process and outcomes. The findings demonstrate that the VR game app positively facilitated EFL learners' acquisition of vocabulary meaning. VR game apps also facilitate learners' vocabulary learning processes through associating, predicting and outsourcing. The VR game app effectively facilitated EFL students' vocabulary learning because it provided multimodal support, an immersive learning input and environment, and real-time interactivity and feedback. Furthermore, EFL students could experience authentic language and construct word knowledge through predicting and associating the meaning of English subtitles into the VR game activities and contexts while they were playing the VR game. VR game apps also motivate EFL students to translate and negotiate meaning after playing the VR game.

The Authors

Langgeng Budianto is a professor in English language and education. Universitas Islam Negeri Maulana Malik Ibrahim Malang. His research interests include CALL teaching and learning and teacher professional development.

UIN Maulana Malik Ibrahim, Malang
Jl. Gajayana 50, Malang, Jawa Timur Indonesia, 65144
E-mail: langgeng@bsi.uin-malang.ac.id

Suparmi Suparmi is an associate professor in English language and education. Universitas Islam Negeri Maulana Malik Ibrahim Malang. Her research interest includes teacher professional development and teaching vocabulary.

UIN Maulana Malik Ibrahim, Malang
Jl. Gajayana 50, Malang, Jawa Timur Indonesia, 65144
E-mail: amisuparmi77@gmail.com

Biyanto Biyanto is a professor in Islamic education. Universitas Islam Negeri Sunan Ampel Surabaya. His research interest educational technology and Islamic education.

UIN Sunan Ample Surabaya
Jl. Ahmad Yani 17, Surabaya, Jawa Timur Indonesia, 60237
E-mail: mrbiyanto@gmail.com

Siti Nurul Azkiyah is a professor in English language and education. Universitas Islam Negeri Syarif Hidayatullah, Jakarta. Her research interest includes teaching vocabulary and reading.

UIN Syarif Hidayatullah, Jakarta
Jl. Ir.H. Juanda 95, Tangerang Jakarta, Indonesia, 15412
E-mail: azkiyah@uinjkt.ac.id

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